

# Major cardiac rupture following surgical treatment for deep sternal wound infection

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## Abstract

We report a case of an 80-year old male patient who sustained a major rupture of the right ventricle after surgical revision of an infected sternotomy wound following coronary artery bypass surgery. The rupture of the right ventricle occurred despite an early wound debridement and the use of negative pressure wound therapy on the sternum that did not provide sufficient stability to the sternum after the sternal wires were removed. The rupture resulted in a major bleeding but by establishing emergent cardiopulmonary bypass, the patient was saved.

**Keywords:** Rupture • Heart • Right ventricle • Deep sternal wound infection • Negative pressure wound therapy

## INTRODUCTION

Deep sternal wound infection (DSWI) following cardiac surgery is a devastating complication with a reported incidence between 1 and 3% and is associated with significant mortality, ranging between 15 and 30% in most of the series [1]. Complications related to the treatment of DSWI are usually minor; however, life-threatening bleeding can occur. These are usually due to the rupture of the right ventricle (RV) that has been reported both following conventional treatment and negative pressure wound therapy (NPWT). Here, we describe a case of major RV rupture after surgical debridement of DSWI.

## CASE

An 80-year old male with a history of obesity, diabetes, Parkinson's disease and pericarditis underwent a quadruple coronary artery bypass graft operation that included anastomosis of the left internal mammary to the left anterior descending artery. A standard median sternotomy was performed and the sternum closed with interrupted stainless steel wires. Immediate postoperative complications included hypotension with acute renal failure, treated with continuous renal replacement therapy, ischaemic stroke and pneumonia requiring prolonged mechanical ventilation and tracheostomy. Sputum cultures revealed *Serratia* species treated with intravenous vancomycin. Three weeks postoperatively, erythema was detected in the lower third of the sternotomy incision. Wound cultures revealed coagulase-negative staphylococci. The patient was afebrile and laboratory examination showed a normal white

blood cell count. Two days later, a surgical debridement of the lower third of the wound was performed, and NPWT applied using polyurethane foam subcutaneously. Five days later, during wound revision, a 2-mm dehiscence was detected in the caudal part of the sternum with loose sternal wires. The manubrium and upper part of the sternum seemed stable with intact wires. It was decided to remove all sternal wires. After debridement, NPWT was continued with the sponge being placed anterior to the sternum and 125-mmHg negative pressure. Two hours later, after the placement of a nasogastric tube in the postanesthesia care unit (PACU), the patient coughed intensively. The NPWT foam immediately filled with blood, and systolic blood pressure dropped from 130 to 70 mmHg. The wound was manually compressed with gauzes, and the patient was taken urgently to the operating room where cardiopulmonary bypass (CPB) was established. A total sternal dehiscence was revealed, with a 7-cm cranio-caudal rupture of the anterior RV wall. With four fingers inserted into the RV, adhesions between the RV and sternum were cut and the heart mobilized from the posterior sternum. The rupture was then closed with an 8 × 2-cm Teflon patch (Bard® PTFE-Felt, Bard Peripheral Vascular, Inc., Tempe, AZ) using a continuous polypropylene suture. After acquiring haemostasis, polyurethane foam was applied between the sternal edges, with a paraffin gauze covering the anterior aspect of the heart. Finally, 40 mmHg negative suction was applied. In total, 19 units of packed red blood cells were administered, mostly through a cell-saver device. The infection resolved and 2 weeks later the sternum was closed ad modum Robicsek. The patient was discharged 9 weeks postoperatively. Three years later, the patient is doing well with a stable sternum and no signs of infection.

## DISCUSSION

Although rare, RV rupture is the most common cause of major bleeding in patients with DSWI following sternotomy, with rates varying from 5.4 to 14.6% [1]. This potentially fatal complication has been reported following both conventional treatment and NPWT.

Various hypotheses have been made regarding the mechanism of injury in RV rupture, including dense adhesions between the posterior surface of the sternum and anterior surface of the RV. During an increase in intrathoracic pressure, the adherent and relatively fixed and overstretched RV wall can rupture [2, 3]. In the present case, following the removal of sternal wires, an episode of coughing probably exerted traction on the RV free wall in opposite directions through the retrosternal adhesions, resulting in disruption of the RV with concomitant bleeding.

The rupture occurred despite an early wound debridement and the use of vacuum-assisted therapy that did not provide sufficient stability to the sternum after removal of wires. Usually, NPWT is applied with a polyurethaned foam and a two-layer technique, the first layer being used between the gap of the open sternal edges and the second layer of foam to cover the wound subcutaneously. Sartipy *et al.* [4] reported 5 cases of major bleeding following NPWT and emphasized the importance of using several protective layers of paraffin gauze to cover the underlying RV. They also recommended a meticulous inspection to discover sharp sternal edges that could damage the RV. This approach has been further substantiated in a retrospective study of 176 patients receiving NPWT therapy for DSWI by Sjögren *et al.* [5]. Therefore, although easily applicable, NPWT therapy can have several pitfalls like RV rupture, and with an increased use of NPWT, concerns have been raised regarding this potentially fatal complication [4, 5].

The unique finding in our case is the large size of the cardiac rupture, 7 cm, and favourable outcome. Arbulu *et al.* described 8 cases of RV bleeding following DSWI and/or sternal dehiscence, including 2 with a 11-cm cardiac wound size. One patient exsanguinated in the ICU after surgical wound revision, but the other survived after cardiac wound closure with pledgeted sutures [2]. Most other reported series on RV rupture have involved smaller (1–3 cm) ruptures with mortality ranging from 0 and 100%, most of them in the 25–50% range [2, 3]. Fortunately, our patient could be transported directly to the operating room very close to the PACU and CPB initiated within 20 min. Furthermore, in our opinion, expedited manual wound compression in the PACU was important in controlling the bleeding.

In summary, this case illustrates that DSWI treatment can be complicated with potentially lethal rupture of the RV. We believe that this complication is not totally avoidable, but the risk can be decreased by ensuring sternal stability and possibly by releasing retrosternal adhesions after wire removal. Furthermore, treatment should not be delayed, and paraffin gauzes or other comparable covers should be used to protect the underlying RV. Finally, an experienced surgeon should perform NPWT revisions in an operating room with access to CPB.

**Conflict of interest:** none declared.

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### eComment. A new protective device for deep sternal wound infection

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We read with great interest the article by Thorsteinsson *et al.* [1], regarding the management of a life-threatening bleed from a disrupted right ventricle in the setting of anterior mediastinitis. Bleeding was controlled with a Teflon patch under cardiopulmonary bypass.

Deep sternal wound infection after cardiac surgery is a dreaded complication and portends serious morbidity. Many surgical techniques are available for the management of this complication. In the last decade, negative-pressure therapy has been used with encouraging results and has emerged as a novel and efficacious strategy for managing patients with post-sternotomy mediastinitis [2,3]. Since adoption of this method of management and the endorsement of its routine use, many have reported a potentially devastating complication of right ventricle rupture [3,4]. Moreover, the US Food and Drug Administration has published a warning against the risk of major bleeding from the application of negative-pressure therapy to the mediastinum. A plethora of techniques to prevent the disruption of the right ventricle during vacuum-assisted therapy has been successful; namely, the release of adhesions between the deeper aspect of the sternum and the right ventricle on initial debridement and wire removal, avoidance of any sharp sternal edges and use of paraffin gauzes between the foam and the right ventricle.

Despite the application of the above-mentioned technical modifications for protecting the heart, dreadful right ventricle ruptures still occur. Ingemansson *et al.* [5] recently published a series of six patients with deep sternal wound infections managed with a new protective device. A semi-rigid plastic rectangular device with a foam pocket fitted base is inserted between the sternal halves. The foam is separated from the anterior aspect of the heart by two layers of Delnet (Delstar Technologies, Inc, Middletown, DE, USA). A second foam is then placed under the base of the device to stabilize the sternal edges.

This device proves to be of tremendous benefit. However, further refinement and development of user-friendly devices will permit the treatment of deep sternal wound infection while attenuating the risk of heart rupture.

**Conflict of interest:** none declared.

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